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XIMA: A new geometrical approach to the design of progressive addition le

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INTRODUCTION

Progressive Addition Lenses (PAL) are lenses with a power increase which permits to the presbyopic user to correct vision defects for different viewing distances. This power progression has associated optical aberrations near the corridor.

Nowadays (PAL) users' requirements are thinner lenses and less aberrations. To give them an answer we have designed a new progressive lens which presents important advantages regarding thickness optimization and aberration reduction.

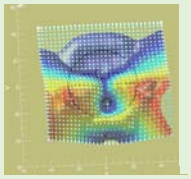
This patented optimized design [1,2] is performed taking into account the parameters that characterize the geometry and positioning of the frame and the prescription of the wearer in order to achieve optimum lens

OPTIMIZATION FEATURES

Aberration reduction

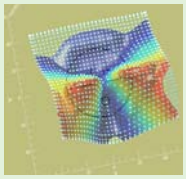
Taking into account the frame shape it is possible to spread oblique astigmatism through non useful zones decreasing the aberrations inside the frame. These aberrations will be edged at the end of the process.

MAXIMA aberrations distribution



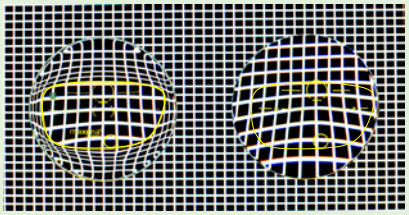
Edged lens

Conventional aberrations distribution



Edged lens

Comparison of distortion

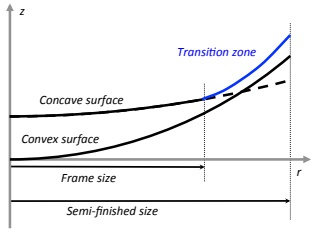


MAXIMA PAL Conventional PAL

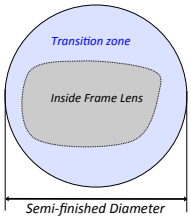
Thickness optimization

In order to get the optimum lens thickness, the concave surface of the lens is re-designed using a transition zone between the lens surface at the edge of the frame and the semi-finished blank edge.

Lens cross section



Lens zones



REFERENCES

1. Patent: WO2010112635(A1). "Finished ophthalmic lens and corresponing method "

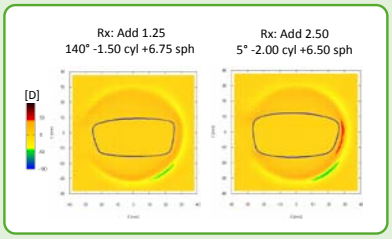
2.-Patent application: P201031037. "Procedimiento de diseño de una lente oftálmica progresiva y lente correspondiente"

ANALYSIS

Due to the curvature change near the frame's edge, the design of these new lenses makes necessary to take under exhaustive control the curvature and the power error in the lens to ensure the optical quality inside the frame.

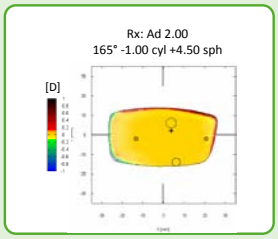
Curvature analysis

The transition between the frame and the semi-finished blank edge can generate critical regions (in red and green) with high curvatures which are controlled and minimized since it can affect the lens quality and the manufacturing process demanding specific low curvature radius tools.



Power error analysis

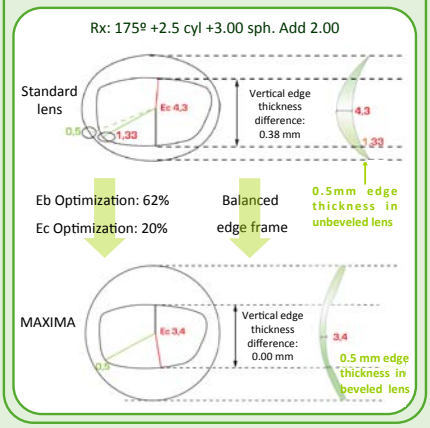
Lens power can suffer slight variations near the edge frame. Deep analysis and clinical tests show that variations are below the perception threshold of the user (yellow zone).



RESULTS

Thickness optimization

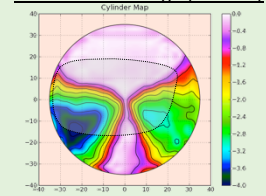
Taking into account the frame edge thickness instead of the semi-finished edge thickness is possible to improve vertical edge balance and center thickness up to 62% and 20% respectively.



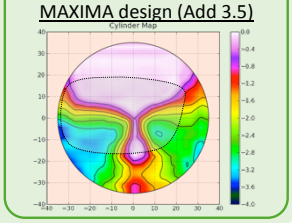
Aberration reduction

Lateral vision field can be improved due to peripheral optical aberrations decrease up to 40%.

Conventional design (Add 3.5)



MAXIMA design (Add 3.5)



CONCLUSIONS

We have designed a new progressive lens which presents important advantages regarding thickness optimization and aberration reduction.

In order to manufacture this new design a new geometry has been developed, which is based on geometrical modifications along the concave.

This process, called **FreeMax**, has lead to the necessity of using specific cutting tools with lower curvature radius to bring the technology of manufacturing of Free-Form lenses to its limits.

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